

Already, however, in history for college students—witness Prof. Bury's recent single volume upon Greece—there is a tendency to keep in view the philosophy of the subject as a higher stratum based upon the facts; and something of the kind may be possible in our text-books of science as time goes on. At present one would like to recommend a pupil to read no text-book, but to buy a number of the shilling volumes written by specialists on the lines and subjects that attract themselves. This, however, would not enable the student to meet the requirements of a university degree. Prof. Park is well aware of this, and has kept himself within traditional bounds. At the same time he makes good use of recent work, including even the Piltown skull (p. 480); and his references to New Zealand and the southern hemisphere introduce a welcome series of examples. The illustrations are numerous and well chosen, though those of ammonites lead to the retention of a somewhat old classification. Formulæ might have been more freely utilised to show the composition of the rock-forming minerals, which are here rather loosely described. The absolutely essential boron would then have appeared as a constituent of tourmaline, and the rhombic pyroxenes would not have been defined merely as "variable silicates." "Titanite" (pp. 197 and 198) is not a synonym for the titanite iron-ores. The explanation of technical terms founded on Greek words is a very useful feature throughout the book.

G. A. J. C.

The West India Committee Map of the West Indies. Scale 55 miles = 1 in. Size 3 ft. 9 in. by 2 ft. 10 in. (London: George Philip and Son, Ltd., 1914.) Mounted on cloth and varnished with rollers, 10s. 6d.; on sheet, unmounted, 7s. 6d.

THE object of the West India Committee in issuing this map is to stimulate interest in the British West Indies. No attempt has been made to give the land relief and other physiographical features of the individual islands—the relative size of the islands in relation to the parts of the mainland shown making such a course impracticable. Prominence is given to railways, sea routes, cables, and other data of commercial importance. Three inset maps are provided: one shows the routes and distances between Canada and the United States and the West Indies, another a plan of the Panama Canal, and a third a graphic representation of the areas and populations of the islands.

The Origin of the World. A Book for Children. By R. McMillan. Pp. xiii + 136. (London: Watts and Co., 1914.) Price 2s. net.

THE object of this little book is to explain, in language simple enough for an intelligent child to understand, the steps in the evolution of our planet, of plant and animal life, and of the human race. The book is written in a pleasant style which should appeal to young readers, arrest their attention, and engender a desire for fuller knowledge.

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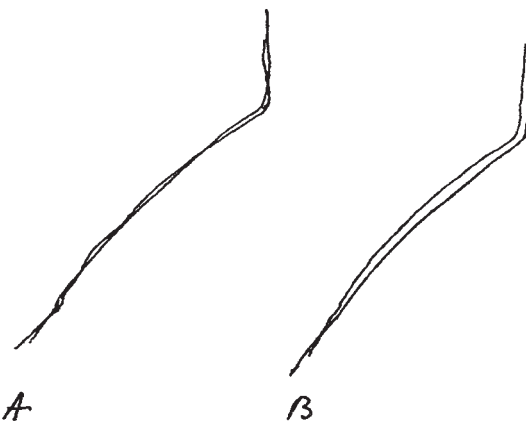
LETTERS TO THE EDITOR.

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Temperature-Difference between the Up and Down Traces of Sounding-Balloon Diagrams.

DR. VAN BEMMEL's letter in NATURE of May 14 is of great interest to me, and seems to prove an appreciable amount of lag in the instruments he uses. Every thermometer must as a matter of course have a certain amount of lag, but I have not been able in the records of the English instruments to detect any sign of it, although there is a marked distinction between records obtained at night or when the sun is low, and those obtained when it is high.

In the diagram, A is the ordinary type of a night ascent, B that of a day ascent. The double trace, one made on the ascent, the other on the descent, is apparent in about every record obtained. It is not often apparent to the naked eye, and hence the diagram is an exaggerated one, but under the microscope by means of which the records are read, the traces in type A can be seen to cross each other here



and there, in type B, on the other hand, the traces are distinct throughout, but the distance between them is plainly variable, ranging often from about 1° to about 3° C. It is very seldom that differences so large as 4° C. are found. In three cases out of four type A will occur at night, and type B when the sun's altitude exceeds 10° , but now and then type B occurs at night, and seems then to indicate an actual change of temperature during the ascent.

In the English instruments the thermograph depends on the temperature of a very thin strip of German silver; this is kept stretched by a small invar tube. The expansion of the invar is nil, and therefore its temperature is of no consequence; the German silver is 0.03 mm. thick, and exposed on both sides to the air current. It is therefore very sensitive as a thermometer; certainly much more so than the Bourdon tube or ordinary metal couple.

I have always accepted the Continental records made in the winter as being free from any systematic error, but have long felt that their summer ascents show temperatures that are persistently too high.

The policy of making all ascents at a fixed time, 7 a.m. G.M.T., seems to me a most unfortunate one

Its advantage is that it is the time of the morning weather chart, and hence the results can be plotted on the chart with the knowledge that all the observations shown are simultaneous. But the objections are two-fold. In many cases figures obtained at great expense have to be rejected, because they are obviously falsified by solar radiation. This must happen if the balloon does not burst, and the sun is high, whereas if the sun is near to or below the horizon it is of no consequence if the balloon does or does not burst. This gives cause for doubt also about some of the printed figures since it is not too clear in all cases as to what may be accepted and what must be rejected. Secondly, it is impossible to get the annual or the daily variation from observations at a fixed hour. The daily variation is, of course, hopeless, and not knowing the law of the daily variation, it is uncertain whether the same correction for the hour should be applied both summer and winter. The result is that the annual variation above 12 km., as shown by the English ascents, many of which were made at sunset before the international time of 7 a.m. was fixed, differs by 3° C. from the Continental value, but it is very improbable that there is any real difference. A plan has now been adopted by which the string carrying the instrument uncoils after the balloon is started, and since last winter a very much longer string has been employed in the English ascents. This avoids the difficulty of starting with a long string in rough weather, and it will be interesting to see what effect the plan will have on the records. The change of length is from 44 to 132 ft.

W. H. DINES.

May 20.

Transmission of Electric Waves Round the Bend of the Earth.

IN a paper on the transmission of electric waves round the earth's surface, read by Prof. H. M. Macdonald before the Royal Society on February 12, some conclusions are recorded which cast new light on the problem of long-distance wireless telegraphy. Prof. Macdonald's point of view is that of simple diffraction, and the paper is the latest one of a notable series of attempts by a number of eminent mathematicians. In the present paper the author reduces his formulæ to figures, and thus makes comparison with experiment easy. The most extensive quantitative experiments yet made over great ranges are those of L. W. Austin in 1910 (Bulletin Bureau of Standards, vol. vii., No. 3), and those of J. L. Hogan in 1913 (*Electrician*, August 8, 1913). From the former experiments Austin and L. Cohen deduced a formula which has been corroborated by Hogan's results. This formula may be written:—

$$i = ce - ax/\sqrt{\lambda}/(\lambda x),$$

where i is the current in amperes in the receiving antenna at the distance x kilometres for the sending station, λ is the wave-length of the radiation in kilometres, a has the value 0.0015, and c , like a , is a quantity which does not depend on λ or x . This formula was deduced from daylight experiments extending over larger ranges of λ and x than those used in the table below.

By aid of this formula Prof. Macdonald's calculations can be quickly compared with the results of experiment. In the following table the first column contains the number of miles between sender and receiver, and the remaining columns contain the ratios of the effect at various distances to that at 419 miles. R_d is the ratio, calculated on the diffraction theory, between the electric fields, R_m is the ratio found by measurement between the currents in the same re-

ceiving antenna when moved to the successive distances in turn.

Miles	$\lambda = 320$ m.		$\lambda = 625$ m.		$\lambda = 1220$ m.		$\lambda = 2560$ m.		$\lambda = 5000$ m.	
	R_d	R_m	R_d	R_m	R_d	R_m	R_d	R_m	R_d	R_m
419	1	1	1	1	1	1	1	1	1	1
536	0.304	0.481	0.392	0.554	0.464	0.605	0.537	0.660	0.585	0.693
675			0.128	0.266	0.184	0.349	0.256	0.418	0.315	0.467
814					0.0764	0.218	0.128	0.282	0.178	0.336
1070							0.0392	0.148	0.0637	0.184
1257									0.0321	0.134

From the table it seems fair to draw the conclusion that diffraction accounts for a large proportion of the observed effects up to distances of, perhaps, 2000 miles. The proportion is much larger than has hitherto been demonstrated, and compels the admission of diffraction into the list of phenomena contributing to the practical success of wireless telegraphy.

But the Austin-Cohen formula expresses a remarkable experimental fact which is not explained, but, rather, is contradicted by the diffraction theory; namely, that for each distance there is a best wave-length. The formula indicates that this optimum wave-length is given by $4\lambda = a^2x^2$, and, consequently, that under the best condition

$$i = 4c(ae)^{-2}x^{-3} = cx^{-3} \times 2.140 \times 10^5,$$

for rather long ranges. These equations are, broadly, borne out by the experience of wireless telegraph engineers. The equation for λ shows that as the wave-length is increased the effect at a given place first increases and then decreases. Here the theory of diffraction appears to fail, for the diffraction effect at any fixed point should increase steadily with increase of wave-length. On the other hand, the hypothesis of the refraction of electric waves in the atmosphere when it is ionised by sunlight seems more promising. For while radiation of very short wave-length is lost into space by the rays suffering too little bending, radiation of great wave-length, by being too strongly refracted, is lost in the ground between the oscillator and the receiver; and thus an optimum wave-length is easily conceivable.

W. ECCLES.

University of London, University College, May 18.

Some Phenomena of Clay Suspensions.

THE interesting letters in NATURE on the cellular structure of emulsions induced me to test the behaviour of clay which I have been accumulating for some time for evaporation experiments. The clay is obtained by the usual sedimentation method, and is that fraction of the soil which does not settle in twenty-four hours in a beaker containing dilute ammonia to a depth of 8.5 cm. The suspension is then evaporated to dryness *in vacuo*.

If some of this dried clay be well shaken up with strong ammonia solution and poured into a Petri dish, the usual network, mentioned by Mr. Wager in NATURE for May 7, gradually develops. Occasionally a different pattern appears, only the angles of the network are formed, and the surface thus has a pitted appearance.

The pattern persists for a few minutes and then gradually becomes blurred. The two cases are shown in Figs. 1 and 2 respectively. In neither case are groups of cells formed. Although the structure is quite sharp to the eye, the lack of contrast makes the photographic difficulties considerable. I am in-